DUAL-PURPOSE COVER CROPS: FORAGE AND GREEN MANURE

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ABSTRACT

Implementation of cover crop usage by farmers is encouraged through the evaluation of different cover crops, species survival, yield, forage quality and green manure/soil nitrogen benefits from multiple locations. This information is needed to reduce the risk of cover crop failure. Finding ways to make cover crops dual-purpose for both livestock forage and a green manure is a way to cover the seeding cost, while having free green manure (natural fertilizer and organic matter). One double crop sequence evaluated was a grain crop, cover crops planted and grazed in the fall, leaving residual for re-growth, a green manure in the spring, and back into a cash crop. The hairy vetch/triticale, Austrian winter pea/cereal or Arvika pea/cereal blends would fit this double crop sequence. Fall yields at the research station with seven weeks of growth after grain in southern Idaho, were the highest for hairy vetch/triticale (8,957 lb/acre). Austrian winter peas/triticale yielded 6,847 lb/acre. As straight legumes, Arvika forage peas at 6,711 lb/acre yielded more than hairy vetch and Austrian winter peas (4,601-4,941 lb/acre). Therefore, an arvika pea and cereal combination is suggested. Another sequence evaluated was a high elevation/limited irrigation. It had a grain crop, was fallowed over the winter, spring cover crops were planted with growth until fall, fall grazing or a green manure, then back to a cash crop. The hairy vetch/triticale, chickling vetch, Austrian winter pea/triticale or Arvika pea/triticale fits this fallow, high elevation/limited irrigation sequence. In an organic system, hairy vetch is not advisable because of its winter survival and persistence. Overall, the legume/cereal blends compared to straight legumes reduced the seeding costs, increased the forage biomass, decreased the relative feed value, but provided more green manure.

Key words: cover crops, green manure, forage yield, forage quality

INTRODUCTION

Cover crops are used as an agricultural best management practice to help minimize soil erosion, prevent nutrient leaching, provide nitrogen for subsequent cash crops, suppress weeds, sequester carbon, increase crop diversity and provide beneficial insect habitats. Dual-purpose cover crops are utilized by producers wanting to achieve an economic advantage in grazing cover crops before utilizing plant residue for soil management. This practice is advantageous for extending the grazing season, reducing nitrogen fertilizer, and increasing soil organic matter content.

Cover crops can be planted in spring, summer, or fall and rotated with a succeeding crop. Fall planted cover crops can be selected based on winter survival. For example, producers may want to plant and graze a fall cover crop that will die in the winter and make residue easy to manage in the spring before cash crop planting. Species that survive the winter achieve additional growth in

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the spring that can be incorporated as a green manure. In this experiment, researchers compared different cover crop planting dates, species and mixtures for yield, forage quality, and soil nitrogen contribution for high-desert farming systems in the intermountain west, under irrigated or limited irrigation conditions.

MATERIALS AND METHODS

This experiment was conducted from May 2012 through June 2013, in southern Idaho at two on-farm trials (Lincoln and Blaine) and a University of Idaho research station. Plot size was 60’ x 5’ on-farm and 30’ x 5’ at the research station, with each site having four replications arranged in a randomized complete block design. Both the research station and Blaine sites were conventionally tilled with the straw baled before planting. The Lincoln site was disked without baling the straw, creating large amounts of residue on the soil surface at planting (seeding rates were adjusted up to compensate). All plots were seeded using an experimental press-wheel drill with six double disc openers spaced on seven inch centers on May 3, 2012 (high-elevation, fallow, limited irrigation Blaine site), Aug. 14, 2012 and Aug. 16, 2012 (following grain harvest, irrigated – Lincoln and research station). Seeding rates for the cover crop species evaluated are listed in Table 1. Forage frame samples were gathered from each replicated plot to determine yield on Aug. 28, 2012 (Blaine), Oct. 3, 2012 (Lincoln), Oct. 9, 2012 (research station), Nov. 14, 2012 (Lincoln), April 16, 2013 (research station) and May 10, 2013 (Lincoln). Composite forage samples at each harvest, from all four replications, were sent to the lab for forage quality analysis. No synthetic fertilizer was applied. Soil samples at one foot depth were taken from each replicated plot on April 25, 2013 (Lincoln), June 18, 2013 (research station) and June 25, 2013 (Blaine) and analyzed for soil nitrate and ammonium. Soil plant available nitrogen data are not shown.

RESULTS AND DISCUSSION

All yields are calculated on a 100% dry matter basis. Fall yields of hairy vetch/triticale were the highest (8,957 lb/acre at the research station), with seven weeks of growth after grain in southern Idaho (Table 2). Next were the warm season annuals ‘Hayking,’ ‘Enorma’ and ‘Special Effort’ sorghum sudangrasses, and triticale yielding 8,481-7,324 lb/acre. Austrian winter pea/triticale and arvika peas followed in yield at the research station with 6,847-6,711 lb/acre. As straight legumes, Arvika forage peas at 6,711 lb/acre yielded more than hairy vetch and Austrian winter peas (4,601-4,941 lb/acre).

Hairy vetch and Austrian winter peas combined with cereals were good legume/cereal mixes, for both fall and spring growth in southern Idaho. Since legume seed is more expensive than cereals, the blends reduce seed costs. Across all three sites, hairy vetch/triticale yields ranged from 7,288-9,257 lb/acre; and Austrian winter pea/cereals yielded 2,400-10,277 lb/acre. Lower yields of Austrian winter pea/cereals came from too much grain residue at the Lincoln site. Visual observations show increased Austrian winter pea winter-kill with lush growth and quick hard freezes in the fall. Therefore, fall grazing to reduce Austrian winter pea forage biomass could be beneficial for winter survival.

When large amounts of biomass were produced by the warm season annuals, they provided carbon and organic matter back into the soil, but limited nitrogen compared to legumes. The standing material left from these cover crops was soil incorporated in the spring at the research station. Only winter hardy crops were evaluated for yield again in the spring. Austrian winter peas were showing signs of re-growth, but had experienced too much stand loss through the winter from voles to calculate spring yield at the research station. Fall yields of ‘Special Effort’ sudangrass at Lincoln were so low compared to the research station because of the large amount of straw left behind and low soil nitrogen in this organic system.

For organic producers, chickling vetch was tested as a legume that would not survive the winter; unlike cold-hardy hairy vetch that can become a weed concern. However, in the fall, chickling vetch had lower yields of 2,730-3,444 lb/acre. Austrian winter peas/cereal yielded better than chickling vetch. Arvika peas yielded more than chickling vetch at the research station and Lincoln site (6,711-5,113 lb/acre). As a winter-kill legume, Arvika peas are better suited for organic systems due to higher fall yields, which means more green manure. The Arvika forage pea’s indeterminate growth and survival at temperatures below freezing into November were advantageous over the chickling vetch. With winter-kill, Arvika pea residue showed visual advantages for weed control in the spring. Therefore, our findings suggest that Arvika peas in combination with a cereal forage is a better choice than chickling vetch for higher yielding fall forage and release of nitrogen early in the spring for subsequent crops with no tillage required.

With four months of growth at the Blaine site (fallow, high elevation/limited irrigation) chickling vetch had the highest yield, followed by Austrian winter peas/triticale, hairy vetch/triticale, triticale and ‘Special Effort’ sorghum sudangrass (Table 2). Hairy vetch and chickling produced large quantities of forage biomass that could have been fall grazed. However, they were utilized as a green manure providing valuable nitrogen and organic matter for subsequent crops.

Relative feed values presented in Table 3 provide a feed quality ratio for the dual-purpose cover crops. Supreme quality forages are over 185, premium 170-185, good 150-170, fair 130-150, and utility <130. At the Lincoln site, forage feed value was comparable to supreme-fair quality alfalfa (238-136 RFV). Legumes alone had higher feed values than when combined with a cereal forage, but a lower yield. At the research station, pearl millet and sorghum sudangrasses had lower feed values (106-100 RFV) comparable to utility quality alfalfa. In contrast the legumes, triticale and pasture mix all had feed values of supreme-fair quality (216-130 RFV) alfalfa. The Blaine site had feed values for hairy vetch, chickling vetch, Austrian winter pea/triticale and triticale comparable to good-fair (158-133 RFV) quality alfalfa. Sudangrass was comparable to utility quality alfalfa.

For livestock feed, hairy vetch should be managed to avoid grazing when it is producing seed. ‘Athena’ winter canola dominated the triticale in April at the research station, increasing the relative feed value, and it contained N concentrations too high for livestock feed. Brassicas (canola etc.) can accumulate nitrate that can kill livestock.

In summary, legume/cereal blends compared to straight legumes reduce the seeding costs, increase the forage biomass, decrease the relative feed value, but provide more green manure. Hairy vetch and Austrian winter peas combined with cereals were a good mix, for both fall and spring growth in southern Idaho. Winter survival will vary based on winter conditions and pest populations. Arvika forage peas provide great fall growth and spring green manure for both conventional and organic producers, and are recommended to mix with a cereal.

Table 1. Dual-purpose cover crop species and seeding rates utilized.

Abbreviation	Cover Crop/Forage Species	Seeding Rate (lb/acre)
AWP/W	Austrian winter peas/volunteer wheat – Lincoln	150
AWP/T	Austrian winter peas/triticale 141 – research station	120/40
AWP/T	Austrian winter peas/triticale 141 – Blaine	100/30
AP	Arvika forage peas	120-150
HV	Hairy vetch	30
HV/trit	Hairy vetch/triticale 141 – Blaine	60/10
HV/trit	Hairy vetch/triticale 141– Lincoln & research station	30/40
CV	Chickling vetch (AC Greenfix)	70
Trit	Triticale 141	112-115
Clover	Arrowleaf clover	10
Pasture	Perennial ryegrass, orchard and meadow brome grass, hairy vetch, cicer milkvetch, arrowleaf clover	20
SS	‘Special Effort’ sorghum sudangrass	50-60
Canola/cereal	‘Athena’ winter canola/volunteer wheat (Lincoln) or triticale (research station)	5-8/40 triticale
PM	Pearl millet	30
Hayking HS	‘Hayking’ hybrid sudangrass	50
FKing HS	‘Forage King’ hybrid sudangrass	50
Enorma HS	‘Enorma’ hybrid sudangrass	50

Table 2. Dual-purpose cover crop mean yields (lb/acre) on a 100% dry matter basis (letters denote statistical difference). Yields collected in the fall of 2012 and spring of 2013.
GM = incorporated as a GM. NP = not planted at this location.

Cover Crop Species	UI Station Oct		UI Station April		Lincoln Oct		Lincoln Nov	Lincoln May	Blaine Aug
HV/Trit	8,957	a	7,288	a	NP		NP	NP	9,257
Hayking HS	8,481	ab	GM		NP		NP	NP	NP
Enorma HS	8,276	abc	GM		NP		NP	NP	NP
Trit	7,596	abcd	GM		NP		NP	NP	8,916
SS	7,324	abcd	GM		760	d	0	0	6,942
AWP/cereal	6,847	bcde	Voles		2,400	b	3,574	3,098	10,277
AP	6,711	bcdef	GM		2,802	a	5,113	0	NP
Canola/cereal	6,507	cdef	4,052	b	200		0	1,902	NP
PM	5,758	defg	GM		NP		NP	NP	NP
FKing HS	5,418	efg	GM		NP		NP	NP	NP
AWP	4,942	fgh	Voles		NP		NP	NP	NP
HV	4,601	gh	3,716	bc	NP		NP	NP	NP
CV	3,444	hi	GM		1,527	c	2,730	0	11,162
Pasture	2,468	i	1,654	cd	NP		NP	NP	NP
Clover	0		675	d	NP		NP	NP	NP
LSD (0.05)	1,878		2,239		338				
R^2	0.74		0.81		0.96				
P>F	0.0001		0.001		0.0001				

Table 3. Relative feed values of dual-purpose cover crops (composite of four reps).

Cover Crop Species	Research Station Oct	Research Station April	Lincoln On-Farm Oct	Lincoln On-Farm Nov	Lincoln On-Farm May	Blaine On-Farm Aug
Clover	0	306	NP	NP	NP	NP
Pasture	216	175	NP	NP	NP	NP
AWP	197	GM	NP	NP	NP	NP
HV	195	161	NP	NP	NP	NP
AP	185	GM	188	191	0	NP
Canola/cereal	183	378	0	0	136	NP
CV	145	GM	176	232	0	133
AWP/cereal	143	GM	237	238	143	158
Trit	141	GM	NP	NP	NP	136
HV/trit	130	74	NP	NP	NP	138
FKing HS	106	GM	NP	NP	NP	NP
Hayking HS	106	GM	NP	NP	NP	NP
PM	103	GM	NP	NP	NP	NP
Enorma HS	103	GM	NP	NP	NP	NP
SS	100	GM	137	0	0	97